placed. Although described under *O. trinitensis* it is probably *O. costaricensis.*

O. trinitensis Maxon, var. *subcostaricensis* Suesseng. & Losch, Mitteil. Bot. Staats. München **1**: 23. 1950. Type: Turrialba, Costa Rica, 1500 m., June 18, 1932, *Kupper 1613,* not seen.

Two other species, *Oleandra guatemalensis* Maxon and *Oleandra panamensis* Maxon grow in Guatemala and in Panama to Colombia respectively. These might possibly occur in Costa Rica, although no specimens of them have been seen from there.

O. panamensis (Fig. 8) differs from the related *O. decurrens* in having the lamina base rather abrupt and the leaf distinctly stipitate above the articulation. In *O. decurrens* the lamina base is gradually reduced and the leaf is subsessile or nearly so above the articulation.

O. guatemalensis (Fig. 9) has long slender phyllopodia like the upper portion of the stipe and small distinctive heart-shaped, almost concolorous scales at the sides of the costa. It differs in these characters from *O. costaricensis* which has the phyllopodium like the rhizome and more elongate, deeply lacerate costal scales. — GRAY HERBARIUM, HARVARD UNIVERSITY.

VASCULAR PLANTS ON THE CINDER CONE OF PARICUTIN VOLCANO IN 1960[1]

JOHN H. BEAMAN

Plants growing on the cinder cone of Parícutin Volcano in 1958 have been reported previously (Beaman, 1960). The present study is based on collections made there on September 8, 1960, two years after the first visit and approximately eight and a half years after volcanic activity ceased. Voucher specimens are filed in the Herbarium of Michigan State University. I am indebted to Dr. R. L. Hauke, Dr. R. McVaugh, Dr. T. R. Soderstrom, and Dr. W. H. Wagner, Jr. for help in the determination of certain species as indicated below.

Ascent and descent of the cone were made on the southwest side. The entire circumference of the rim and both crater vents were examined. The physical features of the cone were about the same in 1958 and 1960. A description and illustrations of the cone, based on a 1957 visit, have been published by Segerstrom (1960).

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EQUISETACEAE.

EQUISETUM HYEMALE L. var. AFFINE A. A. Eat. *(Beaman 4417).* The determination of this species was made by Dr. Hauke. Several stems were present on the northwest rim. These were relatively small, and strobili had not been produced.

POLYPODIACEAE.

PELLAEA TERNIFOLIA (Cav.) Link var. TERNIFOLIA *(Beaman 4414).* Only one small plant, growing on the northeast wall of the crater, was found. This is the area where most of the ferns were collected during the 1958 visit, but not where *P. ternifolia* was previously located. The 1960 collection was sterile, but one of the plants obtained in 1958 had produced sporangia.

PITYROGRAMMA TARTAREA (Cav.) Maxon *(Beaman 4415, 4423, 4431).* This was one of the most frequently observed species on the cone. The determination of collection *4415,* which includes only very young plants, was suggested by Dr. Wagner. The previously reported undetermined juvenile fern *(Beaman 2408D)* may also be this species. Both of these collections are from the northeast wall of the crater. Collection *4423* from the northwest rim of the cone includes plants with sporangia. Collection *4431,* from near a fumarolic vent on a small lava outcrop at the southwest base of the cone, is of plants at about the same developmental stage as those in collection *4423.*

GRAMINEAE.

DIGITARIA SANGUINALIS (L.) Scop. *(Beaman 4412).* Several plants were found in flower on the northeast saddle. In 1958 this area was devoid of plants except for one dicot seedling.

CALAMAGROSTIS MCVAUGHII Sohns *(Beaman 4426, 4429).* The determination of collection *4429* was made by Dr. Soderstrom. In 1958 this species (previously called *C. pringlei*) was found on a lava flow near the east base of the cone. Plants with young inflorescences were well established in 1960 on the northwest rim *(4426)* and at the southwest base near a fumarolic vent on a small lava outcrop *(4429).*

SPOROBOLUS CONFUSUS (Fourn.) Vasey *(Beaman 4410).* Flowering and fruiting plants of this annual species were abundant near the east peak in a local area which was kept moist by a fumarolic vent.

SALICACEAE.

SALIX HARTWEGII Benth. *(Beaman 4423).* This collection was made at the southwest base of the cone near a fumarolic vent on a small lava outcrop. Several plants were also observed on the rim of the cone. Eggler (1959) noted that *S. hartwegii* was one of only two species present in 1950 in volcanic ash on the adjacent north slopes of Cerro Tancítaro.

PHYTOLACCACEAE.

PHYTOLACCA ICOSANDRA L. *(Beaman 4424)*. Several fruiting specimens were found near the west peak. This collection makes it possible to determine the previously reported undetermined dicot seedling *(Beaman 2404)* as the same species.

ERICACEAE.

GAULTHERIA ODORATA Willd. *(Beaman 4408)*. A single plant, about 22 cm. high and with one inflorescence, was found near the east peak. Presumably this shrub had attained its full development in two years, because it was not observed during the 1958 visit.

HYDROPHYLLACEAE.

WIGANDIA KUNTHII Choisy *(Beaman 4420)*. The identity of this collection was suggested by Dr. McVaugh. Three seedlings were found on the northwest rim of the cone.

COMPOSITAE.

ASTER SUBULATUS Michx. var. AUSTRALIS (A. Gray) Shinners *(Beaman 4411, 4438)*. Since 1958 this species (previously called *A. exilis*) has become well established in the area near the east peak. No flowering plants were found in 1958, but in 1960 many of the plants were in flower. One tiny seedling (collection *4438*, probably of this species) was found on the southwest side of the cone about 40 m. below the rim.

BACCHARIS GLUTINOSA Pers. *(Beaman 4428)*. A fairly large, sterile plant was found near a fumarolic vent on a small lava outcrop at the southwest base of the cone. Large flowering specimens *(Beaman 4392)* were collected about three kilometers east of the cone, where the plants were growing in volcanic ash.

CONYZA CANADENSIS L. *(Beaman 4413)*. One small flowering specimen was collected in the northeast saddle on the rim of the cone.

CONYZA CORONOPIFOLIA H. B. K. *(Beaman 4406)*. This species was obtained from near the east peak where it was also collected in 1958. The one plant was in flower and of about average size for the species.

ERIGERON EXILIS A. Gray in S. Wats. *(Beaman 4422)*. One depauperate, but flowering, specimen was found on the northwest rim of the cone.

EUPATORIUM PAZCUARENSE H. B. K. ? *(Beaman 4427, 4432, 4437)*. This species was found at three places on the cone. Two plants were located on the northwest rim *(4427)*; several plants were found at the southwest base on a small lava outcrop *(4432)*; and a small seedling was obtained on the southwest side about 40 m. below the rim *(4437)*.

GNAPHALIUM AMERICANUM Mill. *(Beaman 4407, 4430)*. Two plants of collection 4407, both in flower, were obtained near the east peak. A larger population *(4430)* was found at the southwest base near a fumarolic vent on a small lava outcrop.

GNAPHALIUM SEMIAMPLEXICAULE DC. *(Beaman 4425, 4436)*. One small, sterile plant *(4425)* was located near the west peak. Two other plants *(4436)*, in poor condition, were present on the southwest side of the cone about 40 m. below the rim. Specimens of this species collected in 1958 were more mature and in better condition that those found in 1960.

HETEROTHECA INULOIDES Cass. var. ROSEI Wagenknecht *(Beaman 4416)*. One vigorous rosette was found on the northwest rim of the cone. A flowering specimen *(Beaman 4404)* was collected near San Juan Viejo (formerly San Juan Parangaricutiro) in soil with a high volcanic ash content.

SONCHUS OLERACEUS L. *(Beaman 4421)*. A very small seedling was found on the northwest rim of the cone, but a flowering specimen *(Beaman 4389)* was collected on a volcanic ash deposit near the southwest base of the cone.

UNDETERMINED MATERIAL.

Two additional species *(Beaman 4418* and *4419)* were obtained on the northwest rim of the cone. Collection *4418* consists of one rosette, and *4419* is of two small, caulescent plants. Both may be species of the Compositae.

DISCUSSION

The vegetation on the cone of Parícutin Volcano was much denser and more species were present in 1960 than in 1958. In 1960 the cone flora was made up of 22 species in eight families and 20 genera, while 14 species in six families and 11 genera were present in 1958. Six species *(Pityrogramma calomelanos, Pteridium aquilinum* var. *feei, Pinus montezumae ?, Aegopogon cenchroides, Buddleia cordata,* and *Gnaphalium attenuatum)* reported from the 1958 visit were not relocated in 1960. The number of species of ferns decreased from five to two. The Gramineae increased from one to three species, although the one species found in 1958 was not recollected in 1960. The Compositae, with 10 species in 1960, had doubled its representation in the two-year period. The two woody species *(Pinus montezumae ?* and *Buddleia cordata)* found in 1958 were not relocated in 1960, but they were replaced by three other woody species *(Salix hartwegii, Gaultheria odorata,* and *Wigandia kunthii)*.

In 1958 the moisture from fumarolic vents appeared to be very important in enabling plants to become established on the cone. At that time a majority of the species were concentrated near such areas. In 1960 some of the most vigorous growth was near fumarolic vents around the east peak and at the southwest base. Many plants, however, were also found on the rim of the cone in areas away from fumarolic vapors. Coarse rubble on the outside of the cone and on the crater walls apparently is still not a habitat which vascular plants have been able to successfully invade.

In view of the species present in 1960, it still appears that dispersal by wind is the most important method of transport of propagules to the cone. Nevertheless, animal agencies, possibly birds, were very likely involved in the transport of *Phytolacca icosandra* and *Gaultheria odorata*, species with fleshy fruits. Animals may also be responsible for the dispersal of the grasses, particularly of *Digitaria sanguinalis*, which produces relatively large caryopses. The *Equisetum*, Polypodiaceae, *Salix*, *Wigandia*, and Compositae probably were all dispersed by wind.

Nearly half of the species found on the cone are weedy. These are *Digitaria sanguinalis*, *Phytolacca icosandra*, *Wigandia kunthii*, *Aster subulatus* var. *australis*, *Conyza canadensis*, *C. coronopifolia*, *Gnaphalium americanum*, *Heterotheca inuloides* var. *rosei*, and *Sonchus oleraceus*. It is not surprising that species which are well adapted for colonizing other disturbed and open habitats should be among the first plants to become established on the cone.

The species most vigorous in appearance and numerous in individuals were *Pityrogramma tartarea*, *Calamagrostis mcvaughii*, *Digitaria sanguinalis*, *Sporobolus confusus*, *Salix hartwegii*, *Phytolacca icosandra*, *Aster subulatus* var. *australis*, and *Gnaphalium americanum*. All of these species except *Salix hartwegii* had produced reproductive structures. Seven of the species which were present on the cone in 1958 were also found in 1960, thus demonstrating that these pioneer species were able to maintain themselves on the cone during the two-year period. Four species, *Pityrogramma tartarea*, *Phytolacca icosandra*, *Aster subulatus* var. *australis*, and *Eupatorium pazcuarense ?* have become more abundant since 1958. — DEPARTMENT OF BOTANY AND PLANT PATHOLOGY, MICHIGAN STATE UNIVERSITY, EAST LANSING.

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